OUR ASTRONOMICAL COLUMN.

COMET 1905*b*.—Further observations of this comet are recorded in No. 4056 of the *Astronomische Nachrichten*. As an error was made in the Bamberg record of R.A. on November 18, it became necessary for Herr Ebell to recalculate his elements and ephemeris, and the amended results are contained in Circular No. 81 from the Kiel Centralstelle. The corrected elements are as follows:—

T = 1905 October 25·7163 (Berlin).

$$\left.\begin{array}{l}\omega = 132^\circ\ 34'\cdot9\\ \Omega = 222\ 55\cdot0\\ i = 140\ 37\cdot1\end{array}\right\}1905\cdot0$$
$$\log q = 0\cdot02188$$

The new ephemeris gives the position of the comet, at 12h. M.T. Berlin, on December 10 as α=23h. 30m. 53s., $\delta = -7^\circ\ 24'\cdot1$, but, as its brightness at that time will be only 0·07 of its brightness when discovered (mag. 7·5), the object will be a very difficult one to observe.

THE ANOMALOUS TAILS OF COMETS.—In No. 4, vol. xxii., of the *Astrophysical Journal* Prof. Barnard discusses the anomalous forms presented by the tails of comets. The generally accepted idea is that the tails are produced by the sun's repulsive force acting on the cometary matter, but, from a study of a number of photographs—more especially of Brooks's (1893) comet—Prof. Barnard has arrived at the conclusion that too much importance is attached to this cause, and that the eruptive action of the comet itself, and the active interference of external matter, should also be included amongst the tail-producing causes. Short, straight, minor tails, issuing from the nucleus at considerable angles to the main tail, seem to corroborate the existence of the comet's own eruptive force, or, at least, of some force in addition to that supplied by the sun.

The rapid deflections and distortions of the tail or tails, as in Brooks's comet, suggest the existence of some resisting medium which is not evenly distributed throughout interplanetary space, and such a medium would also explain the anomalous brightening up of some comets (*e.g.* Sawerthal's, May, 1888) and the disruption of such a comet as Biela's.

Finally, Prof. Barnard suggests that all bright comets possessing tails should be photographed hour by hour, as the day by day photographs hitherto obtained are separated by intervals so long that the changes recorded are not necessarily connected.

NOVA AQUILÆ NO. 2.—A number of photographs of the region about Nova Aquilæ, taken with the Bruce telescope, and with the 24-inch reflector of the Yerkes Observatory, are discussed by Mr. J. A. Parkhurst in the November *Astrophysical Journal*. These show that in the spring and summer of 1904 the Nova was at least fainter than the fifteenth magnitude.

The final mean value obtained for the position of the Nova for 1900 was

R.A. = 18h. 56m. 48·96s., dec. = $-4^\circ\ 35'\ 20''\cdot3$,

and a comparison of the images on different plates showed that the Nova was only slightly coloured.

A reproduction of one of the photographs taken with the 24-inch reflector (exposure, three hours) shows that the Nova is situated in a dark lane, almost devoid of stars, in a very rich field in the Milky Way, and also illustrates, in a very striking manner, the connection of Novæ with the galaxy.

CATALOGUE OF BINARY STAR ORBITS.—The results of a critical study of all published double-star orbits are published in Bulletin No. 84 of the Lick Observatory by Prof. R. G. Aitken.

The catalogue is divided into two lists, of which the first, relating to fifty-three stars, contains the elements of those orbits which Prof. Aitken considers to be fairly trustworthy. The second contains the names, the period, and the name of the computer of ninety-one stars of which Prof. Aitken considers the published orbits are too untrustworthy to be of any practical value.

A number of critical and explanatory notes relating to some of the individual stars accompany Prof. Aitken's catalogue.

INDIAN METEOROLOGY, 1892–1902.[1]

SIR JOHN ELIOT, in discussing recent meteorological phenomena, says:—"The period 1892–1902 was unique in the meteorology of India for the magnitude and persistence of the variations of rainfall, cloud, humidity and temperature from the normal."

This period can be divided into two parts, abnormal in opposite directions:—1892–4 characterised by excess of rain, cloud and humidity, and a reduced temperature, and 1895–1902 characterised by deficient rainfall, less cloud, drier air, and an average temperature above the normal.

The normal rainfall for three years (taking the average of 450 selected stations) is 123 inches, while the total rainfall for the period 1892–4 was 143·5 inches, an excess of 20·5 inches. The actual rainfall for the eight years 1895–1902 was 303·8 inches against the normal 328·7 inches, a deficiency of 24·9 inches.

During two years of this dry period the deficiency was so great over certain areas as to cause very severe droughts, which in turn caused famines. These two famines were, both in affected area and affected population, the worst during the last 150 years. The drought of 1896 and the famine of 1897 afflicted the United Provinces, Central Provinces, Central India, and Rajputana, an area of 300,000 to 400,000 square miles, 3,000,000 persons receiving relief. The drought of 1899 and the famine of 1900 affected South Punjab, Rajputana, Central India, Berar, Central Provinces, Hyderabad, Bombay Presidency and part of Orissa, Chota Nagpur, and Madras, an area of 600,000 to 700,000 square miles, and 6,500,000 persons required relief.

In discussing the meteorology of so large an area as India, it is impossible to detail all the local variations, but from among some examples given, Kilba, a station in the Simla district, may be mentioned. During the eleven years under discussion, Kilba for ten years received deficient rainfall, and instead of the normal 441·9 inches received 304·4 inches, the deficiency being equal to 3½ years' normal fall.

Using the data from 450 stations selected by the late Mr. Blandford as most trustworthy and representative, and giving due weight according to the area represented by each station, the average rainfall over India is given in inches:—1892, 46·18; 1893, 50·16; 1894, 47·56; 1895, 38·90; 1896, 36·26; 1897, 40·94; 1898, 41·52; 1899, 29·85; 1900, 40·52; 1901, 36·86; 1902, 39·04, the normal annual rainfall being 41·09 inches. The division of these years into a wet and a dry season is obvious.

On examining the amount of rainfall during the different seasons of the year, the fact is brought out clearly that all the seasons were affected by the abnormal conditions. During 1892–1894 all parts of the year had a tendency to excess rain. In 1893 the dry season had relatively more excess rain than the wet season. During the dry period 1895–1902 there was a tendency to deficiency of rain during all the seasons. Yet during a normal year the meteorological conditions which obtain during the wet season and the dry season are quite inverse of each other.

The persistence of the abnormalities through the seasons is also shown by the observations of cloud amount, humidity and temperature.

Discussing the geographical distribution of the rain, Sir John Eliot points out that during the wet period 1892–4 all parts of India received excess rain except in 1894, when the Bombay and Malabar district and the Madras district were deficient by 2 per cent. and 3 per cent. of the normal respectively. In 1892 the excess was more marked in those areas which received their south-west monsoon rain by the Bombay or Arabian Sea current, in 1893 and 1894 in those areas supplied by the Bay of Bengal current, and the excess was relatively greater in those areas which are near the interior limits of the fields of the two currents. The abnormal extension and strength of the monsoon currents are indicated by this excess in the interior.

During the period there was generally excess rain in

[1] "A Preliminary Investigation of the more Important Features of the Meteorology of Southern Asia, the Indian Ocean, and Neighbouring Countries during the Period 1892–1902." With Appendices. By Sir John Eliot, M.A., F.R.S., K.C.I.E. (Indian Meteorological Memoirs, vol. xvi. part ii.).

Baluchistan, Afghanistan, Persia, Zanzibar, and Mauritius, while the rainfall of Arabia, the Straits Settlements, and Port Blair was generally in defect. The defect at Port Blair is an illustration of the general rule that the rainfall of the Indian Sea area frequently varies inversely with that of the land area.

During the dry period 1895–1902 there was an almost continuous deficiency of rain over North Bombay, Central Provinces, Central India, and the Punjab. There was deficient rainfall for five years in Bengal, for four years in United Provinces and Madras, and for seven years in east and south Punjab. The interior districts suffered more than the coast, and those supplied by the Bombay current more than those supplied by the Bengal current. In 1899 the rainfall of North Bombay was 48 per cent. below the normal, and that of Rajputana and Central India 31 per cent. below. For five years out of eight these areas received at least 20 per cent. less rain than the normal.

The countries bordering on Indian area, and including Australia and South Africa, mostly suffered from want of rain.

During the wet period 1892–4 the monsoons were remarkable for the length of time over which they extended and for the persistence and steadiness of the monsoon conditions. In the dry period 1895–1902 the monsoons were generally characterised by their shortness. In 1896 and 1899, the years of drought, there was no prolonged delay in the commencement of the monsoon rains, but they stopped earlier than usual by three to seven weeks in the case of the Bombay current, and two to six weeks in the case of the Bengal current. This abrupt termination of the rains had a most disastrous effect upon the crops, especially in the Gangetic Plain and the Central Provinces. The crops dried and withered, and famine resulted.

The drought of 1896 was due in the United Provinces to scanty rainfall throughout the whole season, whereas in the Central Provinces and Berar it was due to the early termination of the rains. The year 1899 was characterised by the lack of heavy falls (*i.e.* falls of more than 3 inches in twenty-four hours) over all India, and especially so in the field of the Bombay current.

The data available show that the rainfall for all the countries which depend for their rain on the Indian Ocean was in excess during 1892–4, and in defect during 1895–1902. The rainfall over Russia, Turkestan, and Central Asia varied from the normal in the opposite manner.

The observations of cloud amount, relative and absolute humidity and temperature, show that the curves for these meteorological elements agree very closely with the curve for rainfall.

In discussing the variations of atmospheric pressure, Sir John Eliot refers to the important fact that the long-period variations as disclosed by barometric observations are similar in direction, amount and epoch over the whole of India, and gives both annual and monthly data showing this. Examination of the data giving the monthly variation of pressure from the normal shows that there were fairly long periods of continued excess or defect of pressure, that there was a decided oscillation of pressure. The period of oscillation is given as about two years. Sir Norman Lockyer and Dr. Lockyer, in a recent paper dealing with the rainfall of the Thames basin, refer to the annual pressure variation at Bombay, and speak of a 3·8-year period. Sir John Eliot gives a table showing the approximate dates of the changes from excess pressure and *vice versâ*, and notes that these changes almost invariably occur about the time of the change of season.

If these oscillations were due to exchange of air between the Indian Ocean and southern Asia, such as might accompany the seasonal changes, then the oscillations of pressure over these areas would be of similar period, but of opposite phase; but comparison of the Indian data with data from East Indies, China, South Africa, and Australia shows that this was not generally the case during 1895–1902. In 1893, when there was a deficiency of pressure recorded at Batavia, Singapore, Cape Town, Perth, and Adelaide, there was excess of pressure at Mauritius, Zanzibar, Hong Kong, and Zika Wei, and over India but in other years, notably 1896, 1898, and 1899, there was a general agreement over the whole Indian Oceanic area and southern Asia. According to Sir John Eliot, this was not the case previous to the period under discussion. He says (p. 273):—"It was shown in the memoir[1] that the pressure variation at Mauritius from 1877 to 1889 presented long period oscillations or variations of similar period but opposite phases to the pressure variations in India," and also (p. 276) "the usual relation based upon previous investigations is for the pressure variations in Southern Asia to be of opposite character or sign to those of the Indian Oceanic region." Therefore he concludes that there was some great and abnormal movement of air affecting the barometric pressure over half the eastern hemisphere, but he has no data available to show the region where the opposite variation has taken place.

Sir Norman Lockyer and Dr. Lockyer, in their paper[2] on "The Similarity of the Short Period Pressure Variations over Large Areas," refer to a set of curves representing the pressure variations in Bombay, Colombo, Batavia, Mauritius, Perth, Adelaide, and Sydney, saying "the striking similarity between these curves shows that over the whole of this area, which includes both north and south latitudes, the same kind of variations is in action, and that therefore the whole region is intimately connected meteorologically."

These curves refer to the period 1874 to 1901. Attention might be directed to the fact that the term "long-period" seems to be applied by Sir John Eliot to variations which, when discussed by Sir Norman Lockyer, are called "short-period."

In another paper[3] by Sir Norman Lockyer and Dr. Lockyer two pressure curves are given, one for Bombay and one for Cordoba (Argentine), which are referred to thus:—"Dealing with the pressure of Cordoba during the high pressure months April to September, the curve representing the variation from the mean from year to year is exactly the inverse of the curve representing the Bombay and other Indian pressures for the same months over the same period of time. The cause therefore which raises the mean value for the low pressure months over the Indian area would appear to lower the mean value of high pressure months at Cordoba simultaneously. In fact we have a see-saw."

In a further paper[4] by the same authors, the surface of the globe is divided into two areas, one having the pressure variations of the Indian type and the other those of the Cordoba type.

These quotations show that there is evidently a difference of opinion on the question of the similarity or dissimilarity of the pressure conditions of Southern Asia, Australia, and Africa previous to the year 1892; and it is quite possible that the meteorology of these regions during the period, 1892–1902, was not so abnormal as Sir J. Eliot suggests.

From a discussion of the observations of variation of solar radiation, as indicated by the black bulb thermometer, Sir J. Eliot states that the data indicate that during 1891 to 1896 or 1897 there was an excess of solar radiant energy, and during 1898–1902 there was defect.

As such a defect would diminish the supply of aqueous vapour, and consequently the rainfall, accurate observations of the variations in solar radiation should give an explanation of the variations of the rainfall and air pressure. Observations by means of the black bulb solar radiation thermometers are, however, not considered very satisfactory.

Appendices to this important memoir give extracts from various official reports on the famines of 1897 and 1900 containing information with regard to the damage to crops and cattle. A large amount of data is also given referring to seasonal rainfall, rainy days, pressure, and dates of commencement and termination of the monsoon rains during the period discussed. Twenty-one plates of curves relating to the same observations form a not unimportant part of the volume which they conclude. W. M.

1 "Indian Meteorological Memoirs," vol. vi.
2 *Roy. Soc. Proc.*, vol. lxxi., p. 134.
3 *Roy. Soc. Proc.*, vol. lxx., p. 502.
4 *Roy. Soc. Proc.*, vol. lxxiii., p. 457